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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention is an element which can change electrical energy into light, and relates to a light emitting device available in the field of a display device, a flat-panel display, a back light, lighting, interior design, a sign, a signboard, an electro photography machine, a lightwave signal generator, etc.

[0002]

[Description of the Prior Art]Research of the organic laminated thin film light emitting device of emitting light when the electron poured in from the negative pole and the electron hole poured in from the anode recombine within the organic fluorescent substance inserted into two poles is done actively in recent years. The bright luminescence under a thin shape and low driver voltage and multicolor luminescence by choosing a fluorescent material are the features, and this element attracts attention.

[0003]Since this research showed that an organicity [ C.W.Tang and others of Kodak ] laminated thin film element emitted light to high-intensity, the research institution of (Appl.Phys.Lett.51 (12) 21, p.913-1987), and many is inquiring. The typical composition of the organic laminated thin film light emitting device which the research consortium of Kodak presented, Mg:Ag was provided one by one on the ITO glass substrate as the diamine compound of electron hole transportability, 8-hydroxy kino RINARU minium which is luminous layers, and the negative pole, and the green emission of  $1000\text{-cd/m}^2$  was possible at about [ 10V ] driver voltage. The present organic laminated thin film light emitting device has followed the composition of Kodak fundamentally, although there are some which are changing composition, such as what has provided the electron transport layer other than the above-mentioned element component.

[0004]A luminous layer comprises only a host material, or dopes a guest material to a host

material, and is constituted. Although three-primary-colors \*\*\*\*\* is called for, research of green emission material is following the luminescent material most until now. In red light material and blue light material, research is wholeheartedly made now aiming at the improvement in the characteristic. That from which good luminescence of color purity is obtained with high-intensity especially in blue light material is desired.

[0005]As a host material, the metal complex of quinolinol derivatives including the above-mentioned tris(8-quinolinolato) aluminum, A benzoxazole derivative, a stilbene derivative, a benz thiazole derivative, A thiadiazole derivative, a thiophene derivative, a tetraphenyl butadiene derivative, a cyclopentadiene derivative, an oxadiazole derivative, an oxadiazole derivative metal complex, a benz azole derivative metal complex, etc. are raised.

[0006]Although the metal complex (JP,5-214332,A) which combined a different ligand from a quinolinol derivative in the blue light host material as an example from which the comparatively good performance is obtained, a screw styryl benzene derivative (JP,4-117485,A), etc. are raised, Color purity in particular is not enough.

[0007]On the other hand, to the dopant material as a guest material. Coumarin derivatives including the 7-dimethylamino 4-methylcoumarin by which it is known that it is useful as a laser pigment, Fused aromatic ring derivatives, such as perylene, pyrene, and anthracene, a stilbene derivative, an oligo phenylene derivative, the furan derivative, the quinolone derivative, the oxazole derivative, the oxadiazole derivative, etc. are known.

[0008]

[Problem(s) to be Solved by the Invention]However, the luminescent material (a host material, a dopant material) used for conventional technology had many things with low luminous efficiency which have high power consumption, and things with low endurance which have a short element life. Although red and green and blue three-primary-colors luminescence are called for as a full color display, in red and blue light, that to which a luminous wavelength is satisfied is little, and there are few things with wide width of a light emission peak which have good color purity. What is excellent in endurance and shows sufficient luminosity and the color purity characteristic in blue light especially is needed.

[0009]Even if it used a few existing materials conventionally, cause a luminescent material and an interaction or the desired luminescent color was not obtained for the reason of luminescence of the electron transport material itself being intermingled, and there were problems, like the endurance of that from which efficient light is obtained is short. For example, although the specific phenanthroline derivative was used for the electron transport material at JP,5-331459,A, and efficient light was shown, it crystallized by prolonged energization and there was a problem that endurance was remarkable and short. Although there are a quinolinol metal complex and a benzoquinolinol metal complex to show the characteristic comparatively good for luminous efficiency and endurance, Since these have high bluish green - the

luminescence capability in yellow in this material itself, when it uses as an electron transport material, there is a possibility that luminescence of material itself [ these ] may be intermingled and color purity may get worse.

[0010]This invention solves the problem of this conventional technology, its luminous efficiency is high and an object of this invention is to provide the light emitting device which was excellent in color purity with high-intensity.

[0011]

[Means for Solving the Problem]This invention is an element which photogene exists between the anode and the negative pole and emits light with electrical energy, and is a light emitting device, wherein this element contains an organic fluorescent substance which has the fluorescent skeleton replaced with a phosphorus oxide group.

[0012]

[Embodiment of the Invention]In order that the anode may take out light in this invention, if transparent, tin oxide, indium oxide, Conductive metallic oxide, such as tin oxide indium (ITO), or gold, Especially things for which ITO glass and Nesa glass are used although not limited, such as especially conductive polymers, such as inorganic conductive substances, such as metal, such as silver and chromium, copper iodide, and copper sulfide, a polythiophene, polypyrrole, and poly aniline, are desirable. Since the resistance of a transparent electrode just supplies sufficient current for luminescence of an element, it is not limited, but from a viewpoint of the power consumption of an element, it is desirable that it is low resistance. For example, if it is an ITO board below 300ohms / \*\*, it will function as an element electrode, but since supply of the substrate about 10ohms / \*\* is also attained now, especially the thing for which a low resistance article is used is desirable. Although the thickness of ITO can be arbitrarily chosen according to resistance, it is usually used among 100-300 nm in many cases. Since the glass substrate should just have sufficient thickness for soda lime glass, alkali free glass, etc. to be used, and for thickness also maintain a mechanical strength, it is enough if there is 0.5 mm or more. About the construction material of glass, since the direction with little elution ion from glass is good, alkali free glass is more preferred, but since the soda lime glass which gave barrier coating sealant, such as  $\text{SiO}_2$ , is also marketed, this can be used. An ITO film formation method in particular does not receive restriction an electron beam method, sputtering process, a chemical reaction method, etc.

[0013]the substance in which the negative pole can pour an electron into this organic layer efficiently in this invention -- be, although are not limited in particular, and platinum, gold, silver, copper, iron, tin, zinc, aluminum, indium, chromium, lithium, sodium, potassium, calcium, magnesium, etc. are generally raised, In order to gather electron injection efficiency and to raise an element characteristic, the alloy containing lithium, sodium, potassium, calcium, magnesium, or these low work function metals is effective. However, these low work function

metals have that it is [ much ] generally unstable in the atmosphere, For example, although it can mention as an example with the preferred method of doping a small amount of lithium and caesium, and magnesium (it is 1 nm or less by the thickness gage display of vacuum deposition) to an organic layer, and using an extremely stable electrode for it, Use of mineral salt like lithium fluoride is not limited to these in particular from a possible thing, either. For electrode protection, metal, such as platinum, gold, silver, copper, iron, tin, aluminum, and indium, Or it is mentioned as an example with preferred laminating inorganic substances, such as an alloy using these metal and silica, a titania, and silicon nitride, polyvinyl alcohol, VCM/PVC, hydrocarbon system polymers, etc. It will not be restricted especially if the method of producing these electrodes can also take flows, such as resistance heating, an electron beam, sputtering, ion plating, and coating.

[0014]in this invention, photogene may be any of the gestalt which boiled further 1 electron-hole transporting bed / luminous layer, the 2 electron-hole transporting bed / luminous layer / electron transport layer, the 3 luminous layers / electron transport layer, and the combination substance more than four, and was mixed. That is, as element composition, it is also good like 4 to provide further the layer containing a luminescent material independent or a luminescent material, hole transporting material, and electron transport material other than the multilayer laminated structure of the above 1-3. Although the photogene in this invention helps what emits light itself, and its luminescence, it corresponds to all, and it points out a compound, a layer, etc. which are participating in luminescence.

[0015]In this invention, an electron hole transporting bed laminates an electron hole transportability substance independent or two or more kinds of substances, and is mixed, or is formed with the mixture of an electron hole transportability substance and a macromolecular binding agent. It is required to convey the electron hole from the anode efficiently in inter-electrode [ which was able to give the electric field as an electron hole transportability substance ], hole-injection efficiency is high, and it is desirable to convey the poured-in electron hole efficiently. For that purpose, ionization potential is small, and it is required that the impurity in which hole mobility is large, is further excellent in stability, and moreover serves as a trap should be a substance which is hard to generate at the time of manufacture and use. Although not limited in particular as a substance which fulfills such conditions, N,N'-diphenyl-N,N'-JI (3-methylphenyl)-4,4'-diphenyl-1,1'-diamine, Triphenylamines, such as N,N'-dinaphthyl N,N'-diphenyl-4,4'-diphenyl-1,1'-diamine. A screw (N-allylcarbazole) or screws (N-alkyl carbazole). A pyrazoline derivative, a stilbene compound, a hydrazone system compound, an oxadiazole derivative and a phthalocyanine derivative, The heterocyclic compound represented by the porphyrin derivative, polycarbonate and the styrene derivative which have said monomer in a side chain in a polymer system, Although a polyvinyl carbazole, polysilane, etc. are preferred, a thin film required for element production is formed, and an electron hole

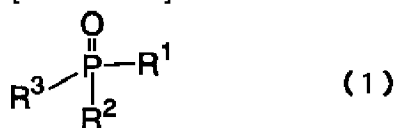
can be poured in from the anode, and it will not be limited especially if it is a compound which can convey an electron hole further.

[0016]The luminescent materials in this invention may be any also in the combination of a host material, a host material, and a dopant material. The dopant material may be included in the whole host material, may be included selectively, or may be any. It may laminate, or may distribute or dopant materials may be any.

[0017]In this invention, a luminescent material contains the organic fluorescent substance which has the fluorescent skeleton replaced with the phosphorus oxide group. As an organic fluorescent substance which has the fluorescent skeleton replaced with the phosphorus oxide group in this invention, the compound specifically expressed with the following general formula (1) or (2) is raised.

[0018]

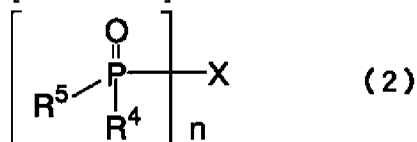
[Formula 3]



[0019] $\text{R}^1 - \text{R}^3$  here, respectively Hydrogen, an alkyl group, A cycloalkyl group, an aralkyl group, an alkenyl group, a cycloalkenyl group, An alkynyl group, a hydroxyl group, a sulfhydryl group, an alkoxy group, an alkylthio group, An aryl ether group, an arylthio ether group, an aryl group, a heterocycle group, It is chosen from halogen, haloalkane, a halo alkene, a halo alkyne, a cyano group, an aldehyde group, a carbonyl group, a carboxyl group, an ester group, a carbamoyl group, an amino group, a nitro group, a silyl group, and a siloxanyl group. At least one of  $\text{R}^1 - \text{R}^3$  is a fluorescent skeleton.

[0020]

[Formula 4]



[0021] $\text{R}^4 - \text{R}^5$  here, respectively Hydrogen, an alkyl group, A cycloalkyl group, an aralkyl group, an alkenyl group, a cycloalkenyl group, An alkynyl group, a hydroxyl group, a sulfhydryl group, an alkoxy group, an alkylthio group, An aryl ether group, an arylthio ether group, an aryl group, a heterocycle group, It is chosen from halogen, haloalkane, a halo alkene, a halo alkyne, a cyano group, an aldehyde group, a carbonyl group, a carboxyl group, an ester group, a carbamoyl group, an amino group, a nitro group, a silyl group, and a siloxanyl group. X expresses a fluorescent skeleton. n expresses two or more natural numbers.

[0022]An alkyl group shows saturated-aliphatic-hydrocarbon groups, such as a methyl group, an ethyl group, a propyl group, and a butyl group, among these substituents, and even if this is replaced also in no replacing, it is not cared about. A cycloalkyl group shows saturated alicyclic hydrocarbon groups, such as for example, cyclopropyl, cyclohexyl, norbornyl, and adamantyl, and even if this is replaced also in no replacing, it is not cared about. An aralkyl group shows the aromatic hydrocarbon group through aliphatic hydrocarbon, such as benzyl and a phenylethyl group, and even if each of aliphatic hydrocarbon and aromatic hydrocarbon is replaced also in no replacing, it is not cared about. An alkenyl group shows an unsaturation aliphatic hydrocarbon group including double bonds, such as a vinyl group, an allyl group, and a butadienyl group, and even if this is replaced also in no replacing, it is not cared about. A cycloalkenyl group shows an unsaturation alicyclic hydrocarbon group including double bonds, such as for example, a cyclopentenyl group, a cyclopentadienyl group, and a cyclohexene group, and even if this is replaced also in no replacing, it is not cared about. An alkynyl group shows an unsaturation aliphatic hydrocarbon group including triple bonds, such as for example, an acetylenyl group, and even if this is replaced also in no replacing, it is not cared about. An alkoxy group shows the aliphatic hydrocarbon group through ether bonds, such as a methoxy group, and even if the aliphatic hydrocarbon group is replaced also in no replacing, it is not cared about. The oxygen atom of the ether bond of an alkoxy group is replaced by an alkylthio group by the sulfur atom. An aryl ether group shows the aromatic hydrocarbon group through ether bonds, such as a phenoxy group, and even if the aromatic hydrocarbon group is replaced also in no replacing, it is not cared about. The oxygen atom of the ether bond of an aryl ether group is replaced by an arylthio ether group by the sulfur atom. An aryl group shows aromatic hydrocarbon groups, such as a phenyl group, a naphthyl group, a biphenyl group, a phenanthryl group, a terphenyl group, and a pyrenyl group, and even if this is replaced also in no replacing, it is not cared about. A heterocycle group shows the cyclic structure group which has atoms other than carbon, such as for example, a furanyl group, a thienyl group, an oxazolyl group, a pyridyl group, a quinolyl group, and a carbazolyl group, and even if this is replaced also in no replacing, it is not cared about. Halogen shows fluoride, chlorine, bromine, and iodine. A part or all of the above-mentioned alkyl groups, such as a trifluoromethyl group, an alkenyl group, and an alkynyl group shows what was replaced with the above-mentioned halogen, and even if haloalkane, the halo alkene, and the halo alkyne are replaced also in no replacing, they do not care about the remaining portion. To an aldehyde group, a carbonyl group, an ester group, a carbamoyl group, and an amino group, aliphatic hydrocarbon, Including what was replaced by alicyclic hydrocarbon, aromatic hydrocarbon, heterocycle, etc., further, even if aliphatic hydrocarbon, alicyclic hydrocarbon, aromatic hydrocarbon, and heterocycle are replaced also in no replacing, they are not cared about. A silyl group shows silicon compound groups, such as for example, a trimethylsilyl group, and even if this is

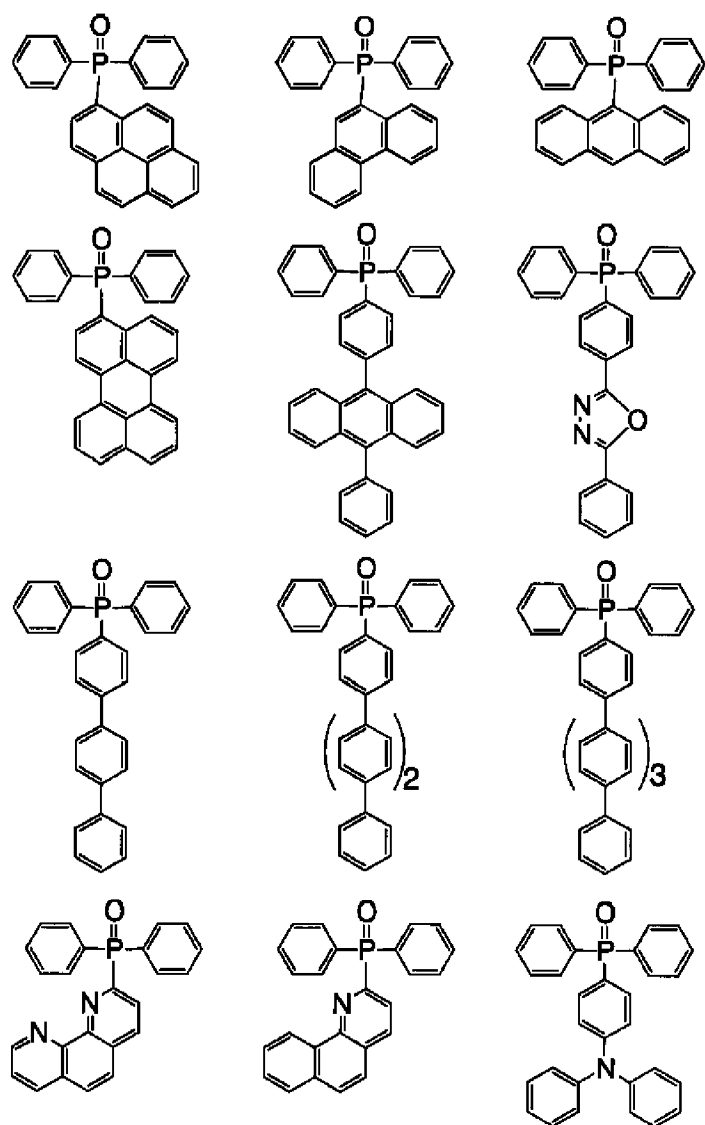
replaced also in no replacing, it is not cared about. A siloxanyl group shows the silicon compound group through ether bonds, such as for example, a trimethyl siloxanyl group, and even if this is replaced also in no replacing, it is not cared about. A ring structure may be formed between contiguity substituents. Even if the ring structure formed is replaced also in no replacing, it is not cared about.

[0023]As a fluorescent skeleton, a skeleton of a dopant material known from the below-mentioned known host material or the former is mentioned. In these fluorescent skeletons being replaced with a phosphorus oxide group, charge transport nature, thin-film-forming nature, etc. can improve, and a light emitting device of high-intensity and high durability can be obtained. In a fluorescent skeleton, fused aromatic rings, such as a phenanthrene, anthranil, pyrenyl, and peri RENIRU, are used suitably.

[0024]As an organic fluorescent substance which has the fluorescent skeleton replaced with the above-mentioned phosphorus oxide group, the following structures are specifically raised.

[0025]

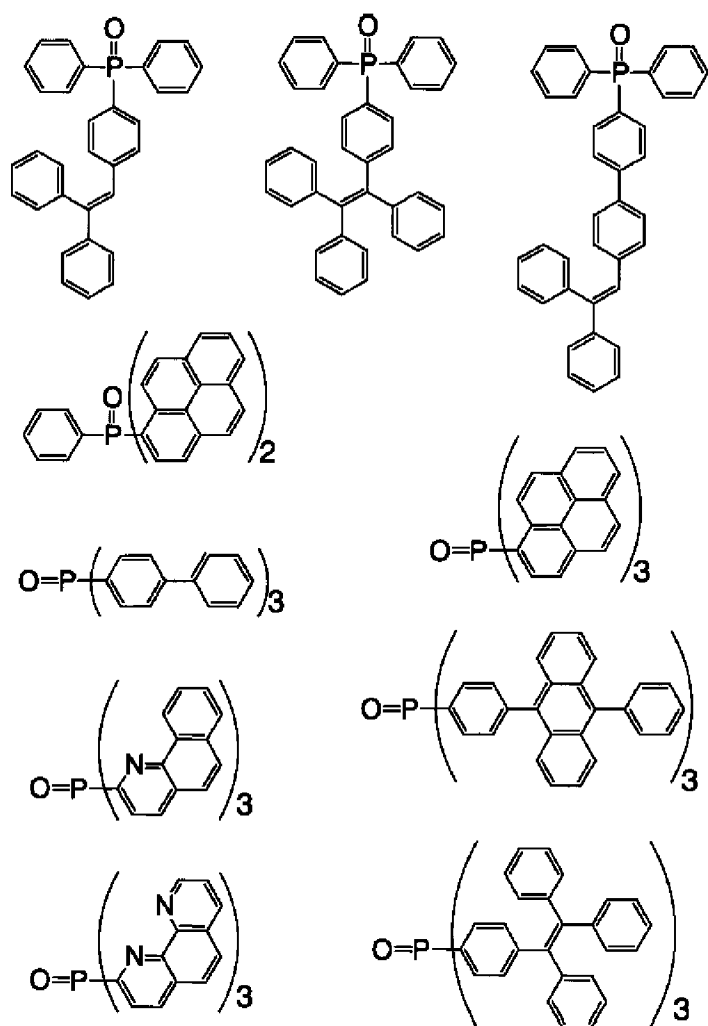
[Formula 5]



[0026]

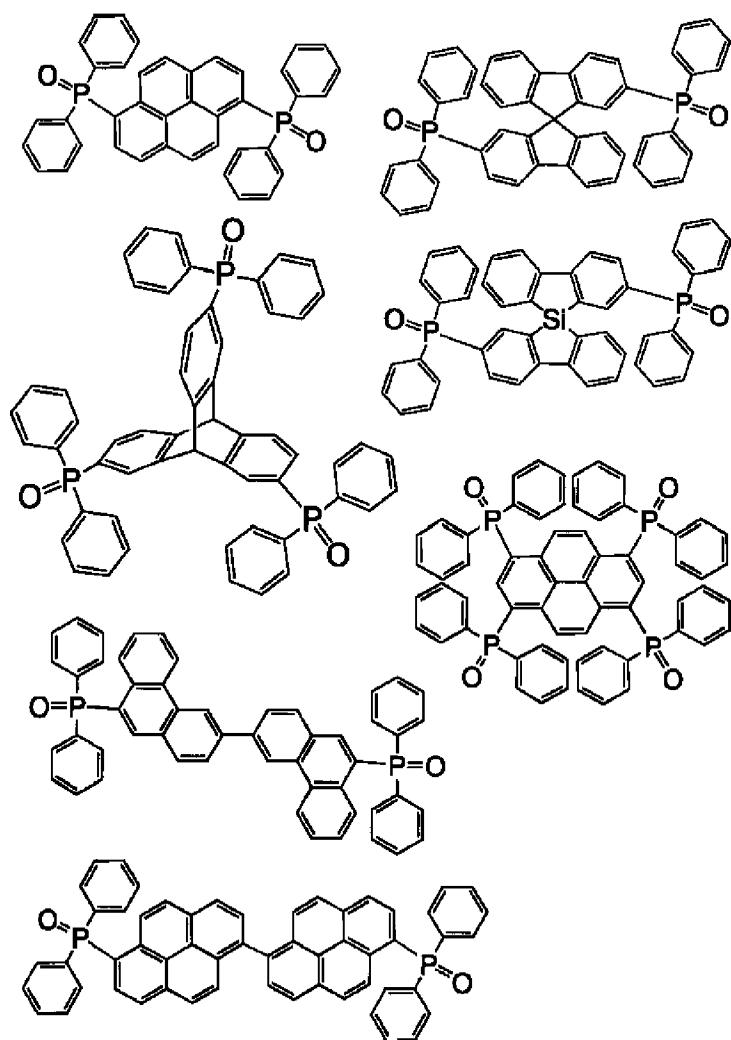
[Formula 6]





[0027]

[Formula 7]



[0028]Although you may use as a charge, since it has the outstanding electron transportation ability, it is suitably used as a host material.

[0029]It is not necessary to restrict a host material of a luminescent material only to an organic fluorescent substance kind which has the fluorescent skeleton replaced with a phosphorus oxide group. An organic fluorescent substance which has the fluorescent skeleton replaced with two or more phosphorus oxide groups may be mixed and used, or it may mix with an organic fluorescent substance which has the fluorescent skeleton replaced with a phosphorus oxide group in one or more kinds of a known host material, and may use. Anthracene known as a photogen for some time although not limited especially as a known host material, Condensed ring derivatives, such as phenanthrene, pyrene, perylene, and a chrysene, A metal complex of quinolinol derivatives including tris(8-quinolinolato) aluminum, A benzoxazole derivative, a stilbene derivative, a benz thiazole derivative, A thiadiazole derivative, a thiophene derivative, a tetraphenyl butadiene derivative, Screw styryl derivatives, such as a cyclopentadiene derivative, an oxadiazole derivative, a screw styryl anthracene derivative, and a JISUCHIRIRU benzene derivative, A metal complex which combined a different ligand from

a quinolinol derivative, an oxadiazole derivative metal complex, In a benz azole derivative metal complex, a coumarin derivative, a pyrrolo pyridine derivative, a peri non derivative, a thiadiazolo pyridine derivative, and a polymer system, a polyphenylene vinylene derivative, a poly para-phenylene derivative, a poly thiophene derivative, etc. can be used.

[0030]Although a dopant material in particular added to a luminescent material is not limited, Phenanthrene, anthracene which are specifically known from the former, Pyrene, tetracene, pentacene, perylene, naphthopyrene, dibenzopyrene, Condensed ring derivatives, such as rubrene, a benzoxazole derivative, a benz thiazole derivative, A benzimidazole derivative, a benz triazole derivative, an oxazole derivative, An oxadiazole derivative, a thiazole derivative, an imidazole derivative, A thiadiazole derivative, a triazole derivative, a pyrazoline derivative, a stilbene derivative, A thiophene derivative, a tetraphenyl butadiene derivative, a cyclopentadiene derivative, Screw styryl derivatives, such as a screw styryl anthracene derivative and a JISUCHIRIRU benzene derivative, A diazaindacene derivative, a furan derivative, a benzofuran derivative, phenylisobenzofuran, Dimesityl isobenzofuran, JI (2-methylphenyl) isobenzofuran, Isobenzofuran derivatives, such as JI (2-trifluoro methylphenyl) isobenzofuran and phenylisobenzofuran, a dibenzofuran derivative, 7-dialkylamino coumarin derivative, 7-piperidino coumarin derivative, 7-hydroxycoumarin derivative, a 7-methoxy coumarin derivative, 7-acetoxy coumarin derivative, 3-benzthiazolyl coumarin derivative, 3-benzimidazolyl coumarin derivative, Coumarin derivatives, such as 3-benzoxazolyl coumarin derivative, a dicyanomethylene pyran derivative, A dicyanomethylene thiopyran derivative, a poly methine derivative, a cyanine derivative, An oxo benz anthracene derivative, a xanthene derivative, a rhodamine derivative, A fluorescein derivative, a pyrylium derivative, a carbostyryl derivative, An acridine derivative, an oxazine derivative, a phenylene oxide derivative, A quinacridone derivative, a quinazoline derivative, a pyrrolo pyridine derivative, a furopyridine derivative, Although a 1,2,5-thiadiazolo pyrene derivative, a peri non derivative, a pyrrolo pyrrole derivative, a squarylium derivative, a violanthrone derivative, a phenazine derivative, an acridone derivative, a diaza flavin derivative, etc. can use it as it is, Especially an isobenzofuran derivative is used suitably.

[0031]Not only the above-mentioned fluorescence (singlet luminescence) material but phosphorescence (triplet emission) material is preferably used as a dopant material. Specifically A porphyrin platinum complex and a tris (2-phenyl pyridyl) iridium complex, A tris {2-(2-thiophenyl) pyridyl} iridium complex, a tris {2-(2-benzo thiophenyl) pyridyl} iridium complex, Although a tris (2-phenylbenzo thiazole) iridium complex, a tris (2-phenylbenzo oxazol) iridium complex, a benzoquinoline iridium complex, etc. are mentioned, it is not limited to these.

[0032]In this invention, electron-transport-property material needs to convey an electron from the negative pole efficiently in inter-electrode [ which was able to give an electric field ], its

electron injection efficiency is high, and it is desirable to convey a poured-in electron efficiently. For that purpose, electron affinity is large, moreover electron mobility is large, it excels in stability further, and to be a substance which an impurity used as a trap does not generate easily at the time of manufacture and use is demanded. However, in mainly playing a role which can prevent efficiently flowing into the negative pole side, without an electron hole from the anode recombining when balance of an electron hole and an electron is considered, even if electron transportation capability is not so high, it has an effect of raising luminous efficiency, on a par with material with high electron transportation capability. Therefore, a hole blocking layer from which the electron transport layer in this invention can prevent movement of an electron hole efficiently is also contained as a thing of homonymy.

[0033]An organic fluorescent substance which has the fluorescent skeleton replaced with a phosphorus oxide group in this invention as a substance which fulfills such conditions is mentioned. It is not necessary to restrict an electron transport material only to an organic fluorescent substance kind which has the fluorescent skeleton replaced with a phosphorus oxide group. An organic fluorescent substance which has the fluorescent skeleton replaced with two or more phosphorus oxide groups may be mixed and used, or it may mix with an organic fluorescent substance which has the fluorescent skeleton replaced with a phosphorus oxide group in one or more kinds of a known electron transport material, and may use. A quinolinol derivative metal complex represented by 8-hydroxy kino RINARU minium as a known electron transport material, It is not limited especially although there are a tropolone metal complex, a flavonol metal complex, a perylene derivative, a peri non derivative, naphthalene, a coumarin derivative, an oxadiazole derivative, an aldazine derivative, a screw styryl derivative, a pyrazine derivative, a phenanthroline derivative, etc. Even when these electron transport materials are independent, it is used, but it does not matter even if it laminates, or mixes and uses it with a different electron transport material.

[0034]Although the material used for the above electron hole transporting bed, a luminous layer, and an electron transport layer can form each class independently, As a macromolecular binding agent, polyvinyl chloride, polycarbonate, polystyrene, Poly (N-vinylcarbazole), polymethylmethacrylate, polybutyl methacrylate, Polyester, polysulfone, polyphenylene oxide, polybutadiene, Hydrocarbon resin, ketone resin, phenoxy resin, Pori Sall John, polyamide, Solvent solubility resin, such as ethyl cellulose, vinyl acetate, ABS plastics, and polyurethane resin, It is also possible to distribute hardening resin, such as phenol resin, xylene resin, petroleum resin, a urea resin, melamine resin, unsaturated polyester resin, alkyd resin, an epoxy resin, and silicone resin, etc., and to use.

[0035]Although a formation method in particular of photogene is not limited [ coating method / resistance heating vacuum evaporation, electron beam evaporation, sputtering, a molecule laminated layers method, ] in this invention, resistance heating vacuum evaporation and

electron beam evaporation are usually preferred in respect of the characteristic. Since thickness of a layer is based also on resistance of photogene, it cannot be limited, but it is chosen from for 1-1000 nm.

[0036]Although electrical energy mainly refers to a direct current in this invention, it is also possible to use pulse current and alternating current. Although a current value and a pressure value do not have restriction in particular, when power consumption of an element and a life are taken into consideration, the luminosity maximum with the lowest possible energy should be made to be obtained.

[0037]In this invention, a pixel for a display says what has been arranged in the shape of a lattice, and a matrix displays a character and a picture by set of a pixel. Shape of a pixel and size are decided by a use. For example, a pixel with a quadrangle of 300 micrometers or less will usually be used for a picture and a character representation of a personal computer, a monitor, and television for one side, and, in the case of a large sized display like a display panel, a pixel of mm order of one side will be used for them. In the case of a monochrome display, a pixel of the same color should just be arranged, but red and a green and blue pixel are displayed [ a case where it is a colored presentation ]. In this case, there are a delta type and a stripe type typically. And as a drive method of this matrix, either a line sequential drive method or an active matrix is OK. Although there is an advantage that structure is simpler for the line sequential drive, since a direction of an active matrix may be excellent when an operating characteristic is taken into consideration, it is required to also use this properly by a use.

[0038]A field which formed a pattern and was decided to display information beforehand decided to be a segment type in this invention is made to emit light. For example, an operating state display of time in a digital clock or a thermometer, a temperature display and audio equipment, an induction heating cooker, etc., a panel display of a car, etc. are raised. And said matrix display and a segment display may live together in the same panel.

[0039]It is used for the purpose of raising the visibility of a display which does not mainly carry out spontaneous light to a back light in this invention, and is used for a liquid crystal display, a clock, audio equipment, an automobile panel, the plotting board, a sign, etc. Since a thing of a conventional system consists of a fluorescent lamp or a light guide plate as a back light of a personal computer use in which slimming down has especially been a technical problem also in a liquid crystal display, if it considers that slimming down is difficult, as for a back light in this invention, a thin shape and a light weight will become the feature.

[0040]

[Example]This invention is not limited by these examples, although an example and a comparative example are given and this invention is explained hereafter.

[0041]Cutting and etching were performed for the glass substrate (the Asahi Glass Co., Ltd.

make, 15ohm/\*\*, electron-beam-evaporation article) on which 150 nm of example 1ITO transparent conducting films were made to deposit to 30x40 mm. After cleaning the obtained substrate ultrasonically for 15 minutes respectively by acetone and the "semi-coculine 56" (made by Furuuchi Chemical Corp.), ultrapure water washed. Then, heat methanol was made to immerse for 15 minutes after cleaning ultrasonically for 15 minutes with isopropyl alcohol, and it was made to dry. Just before producing an element for this substrate, it is 1-hour UV. - It ozonized and installed in the vacuum evaporator, and it exhausted until the degree of vacuum in a device became below  $5 \times 10^{-5}$  Pa. With the resistance heating method, 100 nm of 4,4'-bis(N-(m-tolyl)-N-phenylamino)biphenyls were first vapor-deposited as a hole transporting material. Next, as a luminescent material, diphenyl-2-pyrenyl phosphorus oxide was laminated in thickness of 50 nm. Next, as an electron transport material, the 2,9-dimethyl-4,7-diphenyl-1,10-phenanthroline (BTCNP) was laminated in thickness of 100 nm. Next, after doping lithium to a 0.5-nm organic layer, 200 nm of aluminum was vapor-deposited, it was considered as the negative pole, and the element of the 5x5 mm square was produced. The thickness said here is a crystal oscillation type thickness value monitor value. With the luminous wavelength of 528 nm and a luminosity of 5650 cds/square meter high-intensity blue-green luminescence was obtained from this light emitting device.

[0042]Pyrene was used as comparative example 1 luminescent material, and also the light emitting device was produced completely like Example 1. This light emitting device was not able to be short-circuited and was not able to obtain luminescence.

[0043]Diphenyl-5-phenan SURENIRU phosphorus oxide was used as example 2 luminescent material, and also the light emitting device was produced completely like Example 1. With the luminous wavelength of 486 nm and a luminosity of 401 cds/square meter high-color-purity blue light was obtained from this light emitting device.

[0044]As example 3 luminescent material, using perylene as a dopant material, vapor codeposition of the diphenyl-2-pyrenyl phosphorus oxide used in Example 1 as a host material was carried out to a thickness of 50 nm so that a dopant might be 3wt%, and also the light emitting device was produced completely like Example 1. With the luminous wavelength of 462,490 nm (double peak) and a luminosity of 3150 cds/square meter high-intensity high-color-purity blue light was obtained from this light emitting device.

[0045]As example 4 electron transport material, diphenyl-2-pyrenyl phosphorus oxide was used, and also the light emitting device was produced completely like Example 1. Compared with Example 1, electron transport property improved and driver voltage required to send the same current fell by 3V.

[0046]As example 5 luminescent material, as a host material (8-quinolinolato), aluminum (III) (Alq3), As a dopant material. 9-benzothiazole 2-yl- 1,1,6,6-tetramethyl 2,3,5,6-tetrahydro 1H,4H-11-oxa 3a-aza-benzo [de] anthracen-10-one (coumarin 545T) was used, and also the

light emitting device was produced completely like Example 4. With the luminous wavelength of 520 nm and a luminosity of 30000 cds/square meter high-intensity high-color-purity green emission was obtained from this light emitting device. The initial luminance retention after after-energization 500-hour progress of this light emitting device is not less than 80%, and was maintaining the homogeneous light-emitting surface.

[0047]BTCPN was used as comparative example 3 electron transport material, and also the light emitting device was produced completely like Example 5. The initial luminance retention after after-energization 500-hour progress of this light emitting device is 50% or less, and nonuniformity was seen in the light-emitting surface.

[0048]As example 6 luminescent material, 4,4'-bis(2,2-diphenylvinyl)biphenyl (DPVBi) was used, and also the light emitting device was produced completely like Example 4. With the luminous wavelength of 468 nm and a luminosity of 10000 cds/square meter high-intensity high-color-purity blue light was obtained from this light emitting device.

[0049]Alq3 was used as comparative example 3 electron transport material, and also the light emitting device was produced completely like Example 6. Not only a luminescent material but the electron transport material emitted light (green), and only blue light with bad color purity was obtained from this light emitting device.

[0050]3,6-\*\*\*\*\*- 2,5-JI (3,5-JI t-butylbenzyl) pyrrolo [ 3,4-] [c] pyrrole- 1,4-dione as a host material among example 7 luminescent materials as a dopant material, 4,4-difluoro-1,3,5,7-tetra tolyl 4-\*\*\*\*- 3a,4a-diaza-indacene was used, and also the light emitting device was produced completely like Example 4. With the luminous wavelength of 630 nm and a luminosity of 8000 cds/square meter high-intensity high-color-purity red light was obtained from this light emitting device.

[0051]Alq3 was used as comparative example 4 electron transport material, and also the light emitting device was produced completely like Example 7. Not only a luminescent material but the electron transport material emitted light (green), and only red light with bad color purity was obtained from this light emitting device.

[0052]As example 8 luminescent material, used 4,4' bis(9-carbazolyl)biphenyl (CBP) as a host material, and the tris (2-phenyl pyridyl) iridium complex was used as a dopant material, and also the light emitting device was produced completely like Example 4. With the luminous wavelength of 520 nm and a luminosity of 50000 cds/square meter high-intensity high-color-purity green emission was obtained from this light emitting device.

[0053]The process until it vapor-deposits example 9 each organic layer was performed like Example 1. With the resistance heating method, 150 nm of 4,4'-bis(N-(m-tolyl)-N-phenylamino) biphenyls were first vapor-deposited as a hole transporting material, and the diphenyl-2-pyrenyl phosphorus oxide used in Example 1 was vapor-deposited in thickness of 50 nm. Next, as an electron transport material, the 2,9-dimethyl- 4,7-diphenyl-1,10-phenanthroline was

laminated in thickness of 100 nm. Next, after doping lithium to a 0.5-nm organic layer, 200 nm of aluminum was vapor-deposited and the element of the 5x5 mm square was produced. Thickness here is a crystal oscillation type thickness value monitor value. Good luminescence was checked when carrying out the 1-mA pulse drive (the Duty ratios 1/60, current value of 60 mA at the time of a pulse) of this light emitting device within the vacuum cell.

[0054]The glass substrate (the Asahi Glass Co., Ltd. make, 15ohm/\*\*, electron-beam-evaporation article) on which 150 nm of example 10ITO transparent conducting films were made to deposit was cut to 30x40 mm, and pattern processing was carried out to 300micrometer pitch (remaining 270 micrometers in width) x32 stripe shape with photolithography method. Long side direction one side of the ITO stripe is extended to a 1.27-mm pitch (opening 800 micrometers in width), in order to make an electrical link with the exterior easy. After cleaning the obtained substrate ultrasonically for 15 minutes respectively by acetone and the "semi-coculine 56", ultrapure water washed. Then, heat methanol was made to immerse for 15 minutes after cleaning ultrasonically for 15 minutes with isopropyl alcohol, and it was made to dry. Just before producing an element for this substrate, it is 1-hour UV. - It ozonized and installed in the vacuum evaporator, and it exhausted until the degree of vacuum in a device became below  $5 \times 10^{-4}$  Pa. With the resistance heating method, 150 nm of 4,4'-bis(N-(m-tolyl)-N-phenylamino)biphenyls were first vapor-deposited as a hole transporting material, and the diphenyl-2-pyrenyl phosphorus oxide used in Example 1 was vapor-deposited in thickness of 50 nm. Next, as an electron transport material, the 2,9-dimethyl-4,7-diphenyl-1,10-phenanthroline was laminated in thickness of 100 nm. The thickness said here is a crystal oscillation type thickness value monitor value. Next, they are 16 250-micrometer openings (remaining 50 micrometers in width.) by wet etching to a 50-micrometer-thick covar board. Mask exchange of the mask fairly provided in a 300-micrometer pitch was carried out so that it might intersect perpendicularly with an ITO stripe in a vacuum, and it fixed with the magnet from the rear face so that a mask and an ITO board might stick. And after doping lithium to a 0.5-nm organic layer, 200 nm of aluminum was vapor-deposited and the 32x16 dot-matrix element was produced. When carrying out matrix driving of this element, the character representation was able to be carried out without the cross talk.

[0055]

[Effect of the Invention]Luminous efficiency of this invention is high and the light emitting device excellent in color purity can be provided. It is effective especially for blue light.

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[Translation done.]